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To cite this version:

Julie Nies, Gersende Georg, Marc Faraggi, Isabelle Colombet, Pierre Durieux. Improvement of Inter-Services Communication through a CDSS Dedicated to Myocardial Perfusion Scintigraphy. Studies in Health Technology and Informatics, 2011, 169, pp.135-139. 10.3233/978-1-60750-806-9-135 . hal-01393914

HAL Id: hal-01393914

https://hal.science/hal-01393914

Submitted on 8 Nov 2016

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User Centred Networked Health Care
A. Moen et al. (Eds.)
IOS Press, 2011
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doi:10.3233/978-1-60750-806-9-135

Improvement of Inter-Services Communication through a CDSS Dedicated to Myocardial Perfusion Scintigraphy

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Abstract. This study addresses the question of communication between medical wards and the nuclear medicine department for the realization of myocardial perfusion scintigraphy. It analyses the effects of a reminder for completing the content of an order form. It shows that the CDSS impacted ordering practices. It could be seen as a system enabling to structure the information and improve the quality of orders.

Keywords: medical ward – technical service communication, organization, CDSS, CPOE

1. Introduction

Clinical Decision Support Systems (CDSS) have demonstrated their efficacy in improving clinical practices and patient outcomes [1-3], particularly in the form of on-screen computer reminders [4]. However, previous experimental works, set up in different domains, show the absence of learning effect associated with the reminder effect. For example, Weingarten et al. evaluated telephone reminders to encourage rapid discharge of patients with chest pain without increasing the risk of post discharge complications. Using an alternating-time series design, they showed that the degree of medical compliance to guidelines decreased back to its pre intervention level [5]. Similar effects were reported by Durieux *et al.* with a CDSS dedicated to venous thrombosis prevention: each time the system was inactive, medical practices came back to the initial level before intervention [6].

The present work consists in implementing an on-screen computer reminder to help ordering Myocardial Perfusion Scintigraphy (MPS). It was performed in the Georges Pompidou European Hospital (HEGP), a university teaching hospital in Paris, France. Since its opening in 2000, the hospital has an entirely computerized Hospital Information System (HIS) with patient centered Electronic Health Record (EHR), DxCare® [7]. The EHR allows the computerized prescription of drugs, imaging and laboratory tests by means of a Computerized Physician Order Entry (CPOE) system.

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All MPS orders are made by physicians through the CPOE. Physicians of the nuclear medicine department answer demands and schedule examinations on the basis of information transmitted by prescriber through the CPOE, in a free-text field associated to orders (thereafter called "comment"). This information should describe patient characteristics and the aim of the examination. However, numerous orders are transmitted to the nuclear medicine department with no comment. This lack of information on clinical context leads to the cancellation of many scheduled examinations. Some studies demonstrated that lack of information sharing could lead to misunderstanding [8]. Some common representation is required to communicate about a shared task [9]. Indeed, information contained in the comment (i.e. objective of the examination) is a precondition for the nuclear medicine department to perform the examination. The implementation of a CDSS attached to MPS ordering was required by the nuclear medicine department to improve the transmission of specific patient data needed to schedule the examination. This study analyses the effects of the reminder on content of MPS orders, by checking the existence of a comment associated to orders and seeking for information useful for MPS realization in the comment.

2. Methods

2.1. Intervention

The myocardial perfusion scintigraphy consists in creating functional images of the myocardium showing where the blood is flowing, by following over time the distribution of tracers injected into the blood stream. The MPS may or may not be performed during a stress test (i.e. exercise), measuring to which extend myocardial perfusion and oxygen consumption adapt to exercise. This examination is therefore performed to search for myocardial ischemia and its functional consequences in patients for whom this primary diagnosis is suspected or in case of documented and already treated coronary artery disease for patient and therapy monitoring: evaluation of residual myocardial ischemia under medical therapy, search for post-infarction myocardial viability. Therefore, some knowledge of clinical context and diagnosis objective is needed to anticipate the conditions of tracer administration (*i.e.* at rest, during a muscular effort or during a pharmacological stress) and therefore to appropriately schedule the examination and prepare patients.

All physicians of the hospital could order MPS. The aim of our work consists of characterizing the missing information in the orders which could help them to identify the objective of the examination. The content of the reminder and a dedicated questionnaire have been designed with the physicians performing the MPS. The reminder proposed one or several MPS types to the prescriber according to the patient characteristics and to prevent undesirable or fatal events which could occur in case of medical contraindication for the stress test. It also reminded the prescriber with the dedicated data to be transmitted to the nuclear medicine department.

During the MPS ordering, a dedicated questionnaire appeared once by patient stay. This questionnaire helped the prescriber to complete clinical data required by the patient-specific reminder: 1) coronary disease history, myocardial infarctions and/or revascularization interventions; 2) coronary risks factors when needed, in case of primary diagnosis objective; 3) contra-indications for stress test.

The reminder was displayed to the prescriber, proposing a pre-formatted text to be pasted in the comment attached to the order (Figure 1). The memo proposed by the CDSS is a well structured resume of all the data contained in the questionnaire. An explanation justifying the proposed CDSS memo is also provided to improve the adherence of the prescriber. The memo is not automatically integrated in the order window. The prescriber can have different choices to complete his order: 1) copy/past the CDSS memo in the comment area of the order window, 2) modifies the CDSS memo, or 3) writes his own comment.

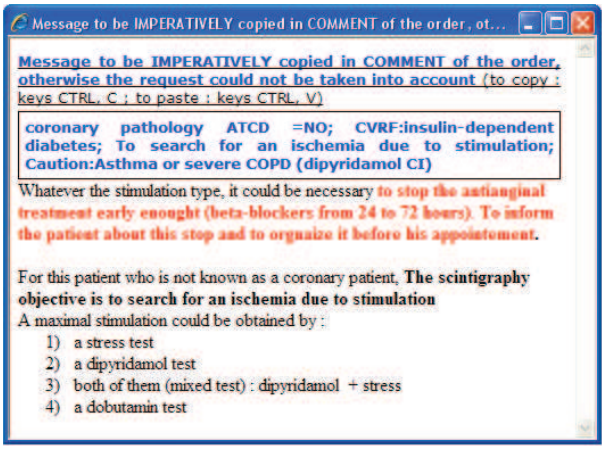

Figure 1: Example of a Myocardial-Scintigraphy-CDSS display: a framed memo and a text justifying the proposed decision support. The reminder content has been translated from French.

2.2. Quantitative Evaluation

During the study period (31 months, from January 2005 to July 2007), the CDSS was activated during two periods (A1 and A2) and not activated during two control periods (C1 & C2). The length of each period was:

- C1 – 23 weeks from 1st January 2005 to 13th June 2005
- A1 – 43 weeks from 14th June 2005 to 13th April 2006
- C2 – 23 weeks from 14th April 2006 to 27th September 2006
- A2 – 43 weeks from 28th September 2006 to 31th July 2007.

In the HIS, it was not possible to directly link the imaging orders with their realization. Thus, we could not verify if the reminder had an impact on the number of MPS cancelled. We analyzed the content of the comments which should be directly affected by the CDSS display. We analyzed the alternated series with 'the number of comments influenced by the CDSS memos' as primary outcome and 'the number of empty comments' as secondary outcome. We evaluated the number of MPS orders and the presence (or not) of associated comments according to the distinct experiment periods. Comments were blindly classified by two authors (JN and GG) in 4 categories: 'Identical', 'Modified', 'Different', and 'Empty' (see Table 1 for categories description). Divergences were resolved by consensus. Comments classified as 'Identical' or 'Modified' correspond to comments influenced by the CDSS.

2.3. Qualitative Evaluation

We performed also a comparative study of the comments content for every period. We used software dedicated to statistical analysis of texts: Tropes™. We focalized on concepts used by the CDSS and appearing in C2 period.

3. Results

3.1. Quantitative Results

Comments typed as 'Identical' and 'Modified' show that the CDSS recommendation has been followed in the A1 and A2 periods, 288 (36.9%) and 314 (39.2%) times, respectively. The percentage of empty comments decreased during and after the first activated period (Table 1).

Table 1: Description of the comments epidemiology according to experiment periods: n (%) [95%CI]. 95%CI: 95% Confidence Intervals for proportions were computed using exact binomial distribution.

Type of comment	C1 (N=859)	A1 (N=779)	C2 (N=323)	A2 (N=801)
Identical (copied and pasted from the CDSS memos)	N/A	75 (9.6%) [7.6-11.9%]	N/A	57 (7.1%) [5.4%-9.1%]
Modified (partly copied and pasted from the CDSS memos with additional information; totally written by the prescriber containing information from the CDSS memos, with or without complementary information)	N/A	213 (27.3%) [24.2-30.6%]	N/A	257 (32.1%) [28.8%-35.4%]
Different (with no link with the CDSS memos)	739 (86.0%) [83.5%-88.2%]	414 (53.2%) [49.5-56.6%]	314 (97.2%) [94.7%-98.7%]	455 (56.8%) [53.3%-60.2%]
Empty	120 (14%) [11.7%-16.4%]	77 (9.9%) [7.8%-12.1%]	9 (2.8%) [1.3%-5.2%]	32 (4.0%) [2,7%-5,5%]

3.2. Qualitative Results

Tropes™ analysis demonstrated that some concepts are present in every study periods, such as the goal of the examination, e.g. 'search for ischemia' or 'search for viability'. However, some concepts which didn't exist in C1 appeared in C2, e.g.: 'contra-indications' (179 occurrences), 'asthma' (11 occurrences), and 'aneurysm' (10 occurrences). Others concepts are more represented in C2, e.g. 6 occurrences representing beta-blocking drugs were retrieved in C1, 37 in C2.

All these concepts were used in the memos proposed in A1. We can thus deduce a type of learning or sensibility to the information to be communicated to the nuclear medicine department.

4. Discussion and Conclusion

Our study suggested that the CDSS could have impacted the MPS orders. The quantitative analysis showed that the percentage of empty comments decreased after the first activated period and that the contents of comments were directly influence by the CDSS display. The qualitative analysis showed that the prescribers still used the CDSS concepts during CDSS inactivation periods. The CDSS could therefore be seen as a system enabling to structure the information and improve the comments quality.

In previous studies [5, 6], the support compensated an error or omission: as long as the system was active, the reminder was efficient but all effects stopped when the system was disabled. In our experiment, the support was used to structure reasoning which is always done by the prescriber but which is not reported along with the order.

Our study has some limits. 1) The CDSS which was stopped in April 2006 was reintroduced in September 2006 upon request from the nuclear medicine department physicians who had noticed a difference in the comments content. Consequently, study periods have different length. The reintroduction of the CDSS confirmed their observation. 2) Patient profiles were not analyzed but we have no reasons to believe that patient profiles changed over time.

In a further work, we will specifically analyze the content of the 'Modified' comments from A1 and A2 periods in order to determine the information which is not displayed by the CDSS but considered important to be communicated by the prescriber.

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